# MI-60 RECYCLER AND LAB BPM MEASUREMENTS

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Recycler BPM's and their pre-amps in the MI-60 sector (HP523 to VP627) were tested to establish a representation of the operational reliability of the recycler BPM system. The measurements were then replicated in the lab, which allowed us to understand the BPM responses and to make corrective actions where possible.

MI-60 Measurements:

The BPM was left in the circuit since it forms part of the 7.5 MHz BPF resident in the pre-amp, and the 15 KΩ serves as isolation between the RF source and the BPM impedance.
A 0 dBm, 7.5 MHz, CW signal from an HP 8047A RF signal generator was connected to the BPM- pre-amp unit. A splitter and 15 KΩ resistors were also connected at the input A and B of the pre-amp-BPM unit.
Three position measurements were made, one with 7.5 MHz into both channels, one with a 3dB attenuator pad in channel A and the third with a 3 dB pad in channel B. The reported position (in mm) was read from the MI-60 VME BPM controller via a portable computer in the tunnel.

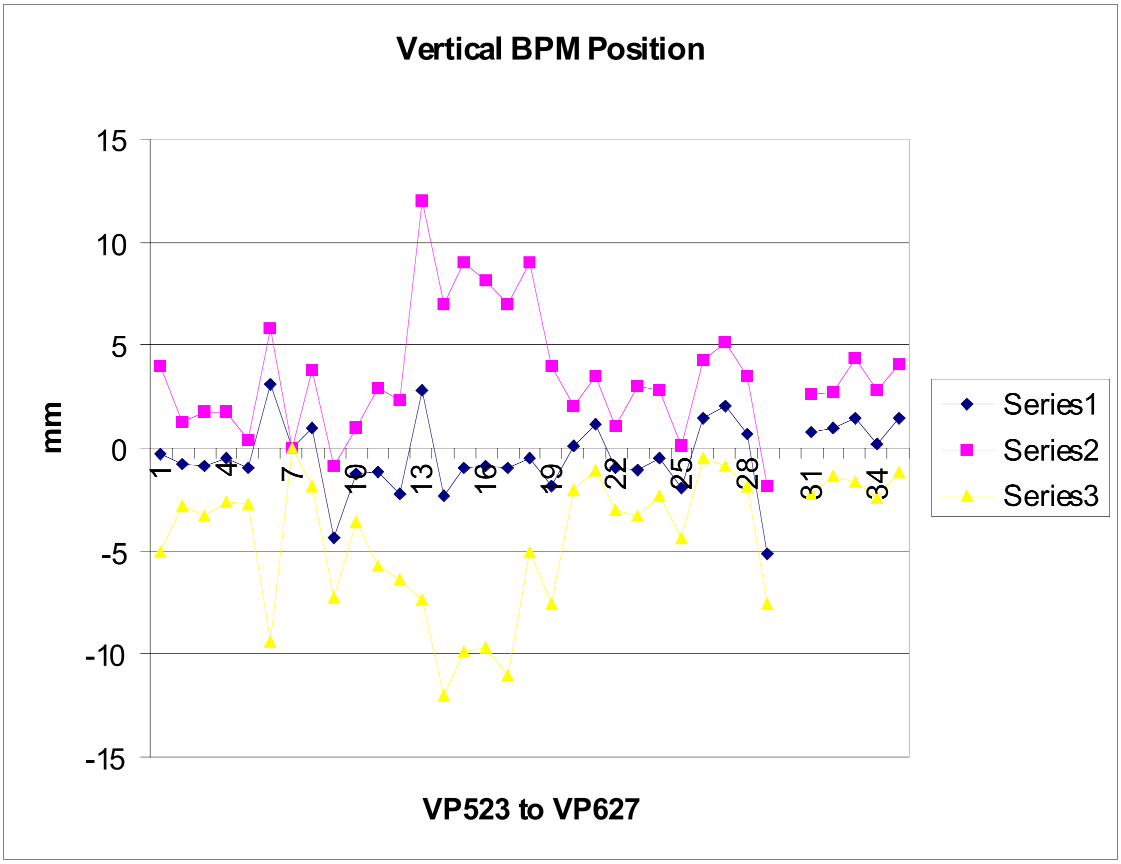
| detector | 0 dBm no pad mm | three dB pad chA mm | three dB pad ch B mm | ch. Gain | Gain mm/dB | Average |
|---|---|---|---|---|---|---|
| HP 523 | -8.9 | -0.8 | -16 | -4.76 | 0.0927083 | -8.5666667 |
| VP 523 | -0.3 | 4 | -5 | -2.54 | 0.01 | -0.4333333 |
| HP 524 | -12 | -4.9 | -19 | -4.76 | 0.1052632 | -11.966667 |
| VP 524 | -0.8 | 1.3 | -2.8 | -2.54 | 0.047619 | -0.7666667 |
| HP525 | -2 | 5.3 | -9.2 | -4.76 | 0.0362319 | -1.9666667 |
| VP525 | -0.9 | 1.7 | -3.3 | -2.54 | 0.0454545 | -0.8333333 |
| HP526 | -3.4 | 3.7 | -9.6 | -4.76 | 0.0590278 | -3.1 |
| VP526 | -0.5 | 1.7 | -2.6 | -2.54 | 0.0320513 | -0.4666667 |
| HP527 | -10 | -2.9 | -16 | -4.76 | 0.1041667 | -9.6333333 |
| VP527 | -1 | 0.4 | -2.7 | -2.54 | 0.0617284 | -1.1 |
| HP528 | 1.1 | 7.5 | -5.8 | -4.76 | -0.0316092 | 0.9333333 |
| VP528 | 3.1 | 5.8 | -9.4 | -2.54 | -0.0549645 | -0.1666667 |
| HP529 | 1.2 | 8.6 | -6.4 | -4.76 | -0.03125 | 1.1333333 |
| VP529 | 20 | 20 | 20 | -2.54 | 0.1666667 | 20 |
| HP530 | 3.2 | -4.2 | 10 | -4.76 | 0.0533333 | 3 |
| VP530 | 1 | 3.8 | -1.8 | -2.54 | -0.0925926 | 1 |
| HP531 | -0.9 | 6.5 | -7.7 | -4.76 | 0.0194805 | -0.7 |
| VP531 | -4.4 | -0.91 | -7.3 | -2.54 | 0.1004566 | -4.2033333 |
| HP532 | -0.4 | 6.8 | -7.6 | -4.76 | 0.0087719 | -0.4 |
| VP532 | -1.3 | 0.93 | -3.6 | -2.54 | 0.0601852 | -1.3233333 |
| HP601 | 1.7 | 8.5 | -5.8 | -4.76 | -0.0488506 | 1.4666667 |

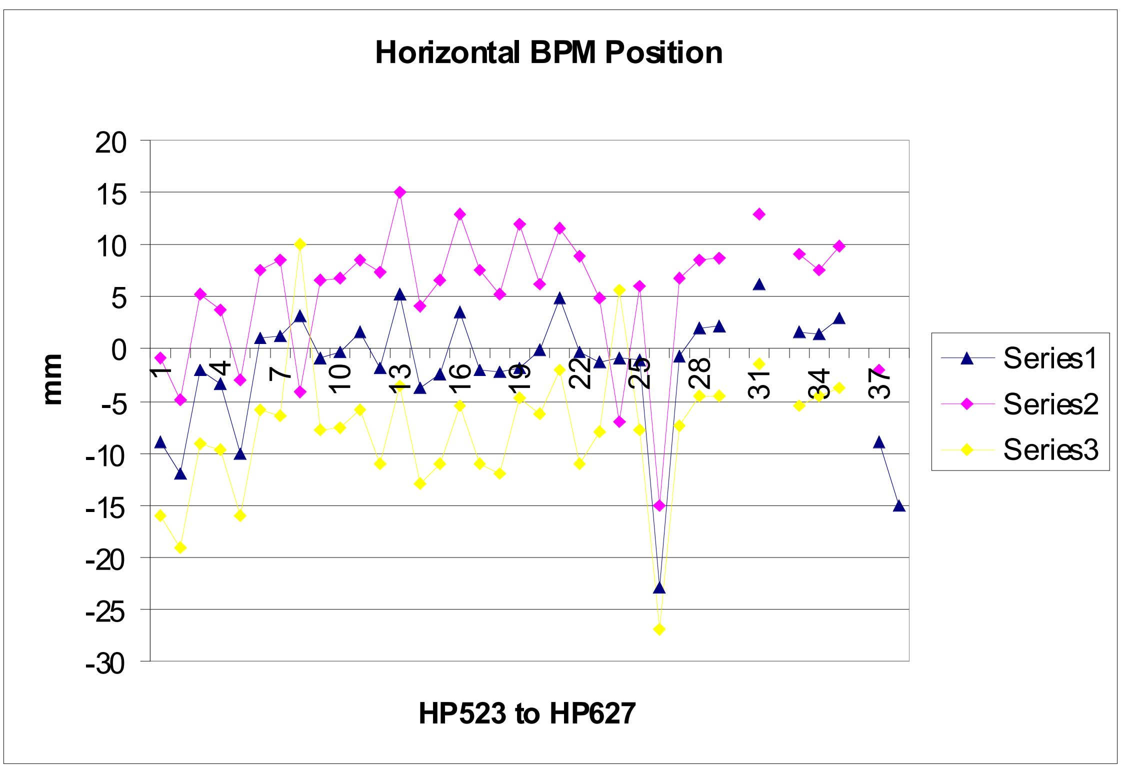
| | | | | | | |
|---|---|---|---|---|---|---|
| VP601 | -1.2 | 2.9 | -5.7 | -2.54 | 0.0350877 | -1.3333333 |
| HP602 | -1.8 | 7.4 | -11 | -5.53 | 0.0272727 | -1.8 |
| VP602 | -2.2 | 2.3 | -6.4 | -2.54 | 0.0572917 | -2.1 |
| HP603 | 5.3 | 15 | -3.5 | -5.53 | -0.252381 | 5.6 |
| VP603 | 2.8 | 12 | -7.4 | -5.53 | -0.0630631 | 2.4666667 |
| HP604 | -3.8 | 4.1 | -13 | -5.53 | 0.0487179 | -4.2333333 |
| VP604 | -2.3 | 7 | -12 | -5.53 | 0.0319444 | -2.4333333 |
| HP605 | -2.4 | 6.6 | -11 | -5.53 | 0.0363636 | -2.2666667 |
| VP605 | -1 | 9 | -9.9 | -5.53 | 0.016835 | -0.6333333 |
| HP606 | 3.6 | 13 | -5.4 | -5.53 | -0.1111111 | 3.7333333 |
| VP606 | -0.9 | 8.1 | -9.7 | -5.53 | 0.0154639 | -0.8333333 |
| HP607 | -2.7 | 7.6 | -11 | -5.53 | 0.0409091 | -2.0333333 |
| VP607 | -1 | 7 | -11 | -5.53 | 0.0151515 | -1.6666667 |
| HP608 | -2.2 | 5.2 | -12 | -5.53 | 0.0305556 | -3 |
| VP608 | -0.5 | 9 | -5 | -5.53 | 0.0166667 | 1.1666667 |
| HP609 | -1.8 | 12 | -4.8 | -5.53 | 0.0625 | 1.8 |
| VP609 | -1.8 | 4 | -7.5 | -5.53 | 0.04 | -1.7666667 |
| HP610 | -0.1 | 6.2 | -6.2 | -4.76 | 0.0026882 | -0.0333333 |
| VP610 | 0.1 | 2 | -2 | -2.54 | -0.0083333 | 0.0333333 |
| HP611 | 4.8 | 11.5 | -2 | -4.76 | -0.4 | 4.7666667 |
| VP611 | 1.2 | 3.5 | -1.1 | -2.54 | -0.1818182 | 1.2 |
| HP612 | -0.3 | 8.8 | -11 | -4.76 | 0.0045455 | -0.8333333 |
| VP612 | -1 | 1.1 | -3 | -2.54 | 0.0555556 | -0.9666667 |
| HP613 | -1.3 | 4.9 | -7.9 | -4.76 | 0.0274262 | -1.4333333 |
| VP613 | -1.1 | 3 | -3.3 | -2.54 | 0.0555556 | -0.4666667 |
| HP614 | -0.8 | -7.1 | 5.6 | -4.76 | -0.0238095 | -0.7666667 |
| VP614 | -0.5 | 2.8 | -2.3 | -2.54 | 0.0362319 | 0 |
| HP615 | -1 | 6 | -7.8 | -4.76 | 0.0213675 | -0.9333333 |
| VP615 | -1.9 | 0.12 | -4.4 | -2.54 | 0.0719697 | -2.06 |
| HP616 | -23 | -15 | -27 | -4.76 | 0.1419753 | -21.666667 |
| VP616 | 1.5 | 4.3 | -0.5 | -2.54 | -0.5 | 1.7666667 |
| HP617 | -0.7 | 6.8 | -7.3 | -4.76 | 0.0159817 | -0.4 |
| VP617 | 2 | 5.1 | -0.9 | -2.54 | -0.3703704 | 2.0666667 |
| HP618 | 2 | 8.5 | -4.6 | -4.76 | -0.0724638 | 1.9666667 |
| VP618 | 0.7 | 3.5 | -1.8 | -2.54 | -0.0648148 | 0.8 |
| HP619 | 2.1 | 8.7 | -4.6 | -4.76 | -0.076087 | 2.0666667 |
| VP619 | -5.1 | -1.8 | -7.5 | -2.54 | 0.1133333 | -4.8 |
| HP620 | | | | -4.76 | #DIV/0! | 0 |
| VP620 | | | | -2.54 | #DIV/0! | 0 |
| HP621 | 6.2 | 13 | -1.5 | -4.76 | -0.6888889 | 5.9 |
| VP621 | 0.8 | 2.6 | -2.2 | -2.54 | -0.0606061 | 0.4 |
| HP622 | | | | -4.76 | #DIV/0! | 0 |
| VP622 | 0.95 | 2.7 | -1.4 | -2.54 | -0.1130952 | 0.75 |
| HP623 | 1.7 | 9.1 | -5.4 | -4.76 | -0.0524691 | 1.8 |
| VP623 | 1.5 | 4.4 | -1.6 | -2.54 | -0.15625 | 1.4333333 |
| HP624 | 1.5 | 7.5 | -4.5 | -4.76 | -0.0555556 | 1.5 |
| VP624 | 0.2 | 2.8 | -2.4 | -2.54 | -0.0138889 | 0.2 |
| HP625 | 3 | 9.8 | -3.8 | -4.76 | -0.1315789 | 3 |
| VP625 | 1.5 | 4.1 | -1.2 | -2.54 | -0.2083333 | 1.4666667 |
| HP626 | -9 | -2 | | -4.76 | #DIV/0! | -3.6666667 |

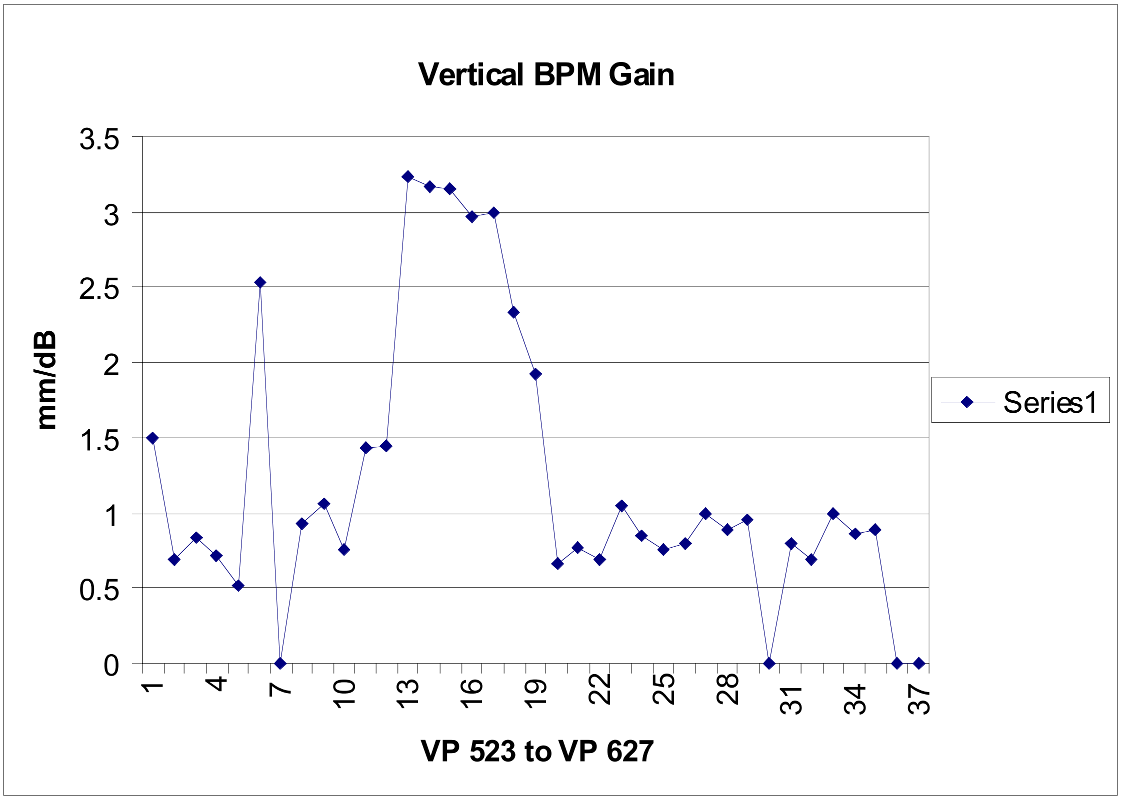
| | | | | |
|---|---|---|---|---|
| VP626 | | -2.54 | #DIV/0! | 0 |
| HP627 | -15 | -4.76 | #DIV/0! | -5 |
| VP627 | | -2.54 | #DIV/0! | 0 |

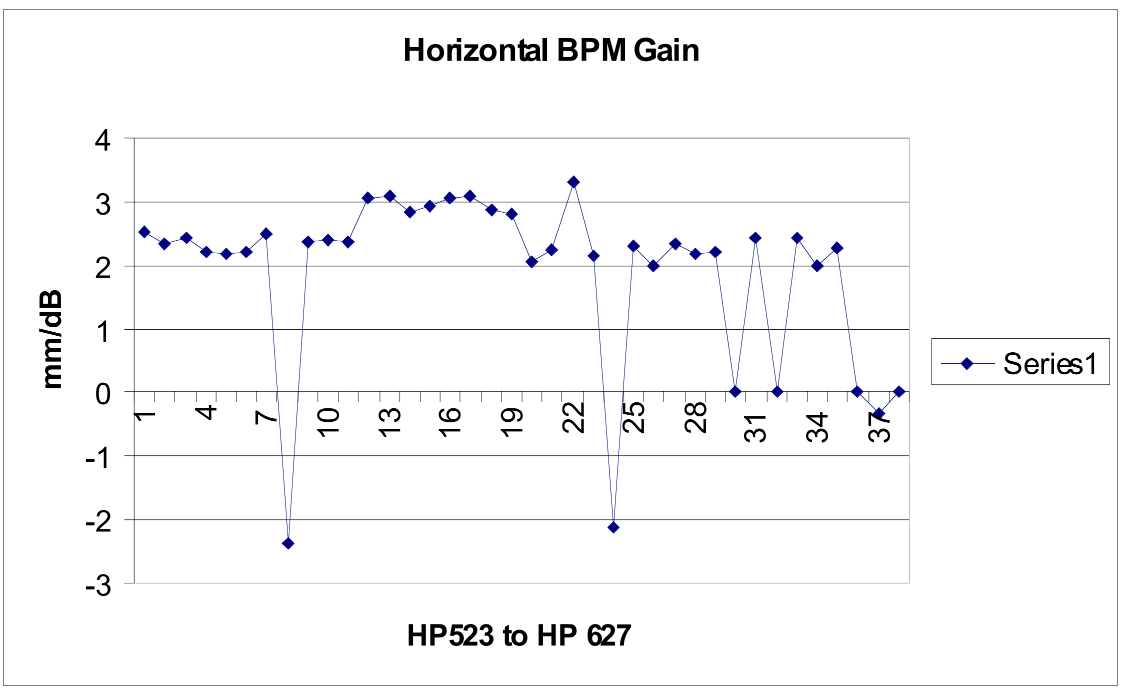
The above table has the measured results for horizontal and vertical BPM’s.

1. The following BPM’s were not measured: HP522, VP522, VP620, HP620, HP622, VP626.
2. The data also showed the following BPM’s to be defective: VP626, HP627, VP627, VP529, HP616.
3. There were two BPM’s whose A and B connections were reversed HP530, HP614.


Vertical BPM Position
mm
15
10
5
0
-5
-10
-15
1
4
7
10
13
16
19
22
25
28
31
34
VP523 to VP627
Series1
Series2
Series3


Horizontal BPM Position
mm
20
15
10
5
0
-5
-10
-15
-20
-25
-30
1
4
7
10
13
16
19
22
25
28
31
34
37
HP523 to HP627
Series1
Series2
Series3




The data for a 0 dBm, 7.5 MHz RF drive signal connected to both channels, shows there can be fairly large excursions from the expected 0 mm position as seen on the position charts for horizontal and vertical BPM's.

MI-60 Horizontal BPM’s

For an expected 6 dB attenuation range there should be a +/- 10 mm deviation span in position about zero. The data reflects this expectation except for the 8 GeV-style BPM’s whose gain factor is - 5.53 rather than the – 4.76 used for the recycler-style BPM’s. Only in one case HP609 the span is skewed in the positive direction.
The BPM gain in mm/ dB, can be calculated from the span data as G = ( Pos A – Pos B ) / 6 dB And the measured average is ~ 2.3 mm / dB as seen on the horizontal gain plot. The expected gain is 3.66 mm / dB. Again 8 GeV style BPM have a slightly higher gain due the multiplication factor.

MI-60 Vertical BPM’s

There appears to be less dispersion about zero for this set of data, until the vertical BPM gain plot is reviewed. Here data shows a significantly smaller than expected detector gain, lees than 1 mm/dB, where the expected gain is closer to 1.95 mm / dB.
Both gain and position graphs show the 8 GeV-style BPM have the expected +/- 10 mm span for 6 dB change, although the gain is 3 mm/ dB which is greater than the expected 1.95 mm / dB. The discrepancies, large gain/span vs. small gain/span differences between detector types are not attributable to the gain difference alone.

Test Measurements

To understand some of the issues, a Lab setup was established to analyze the contributing elements:

1. CW RF signal vs. Pulsed RF
2. The effect in using pre-amps tuned with Horizontal BPM’s with Vertical BPM’s and vice versa.
3. The use of coupled pre-amps vs. un-coupled pre-amps.
4. The effect of sampling time on position.
5. 7.5 MHz RF source vs. 2.5 MHz RF source.

The Circuit model for the BPM-pre amp is the following :

The BPM plate capacitance forms a resonant circuit with the choke and the 1.5 KΩ resistor. Each circuit half BPF is tuned to 7.5 MHz with the circuits being capacitively coupled. The RF source is connected through a 15 KΩ series resistor/splitter combination.

Coupling Measurements:
To measure coupling, the RF source was disconnected at one of the inputs while measuring the signal at channel's A and B at the input of the log-amp card.

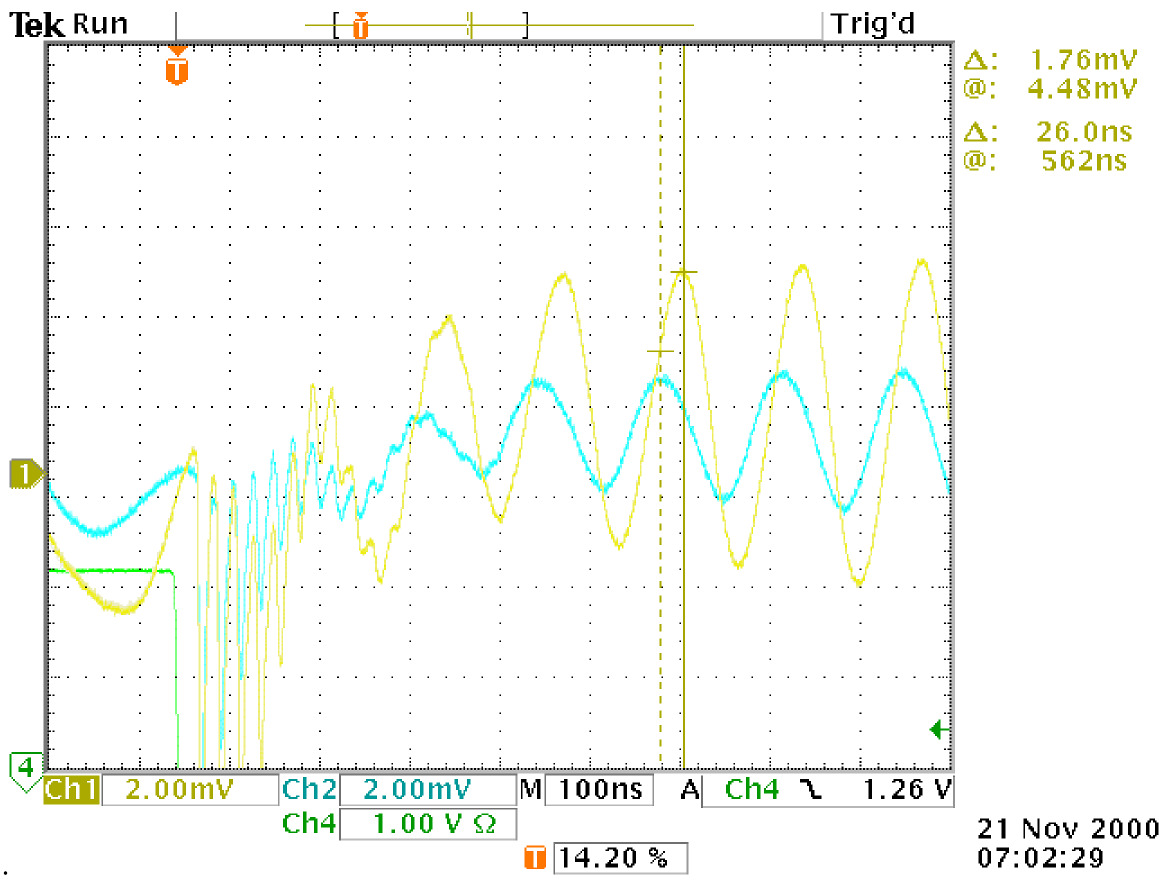



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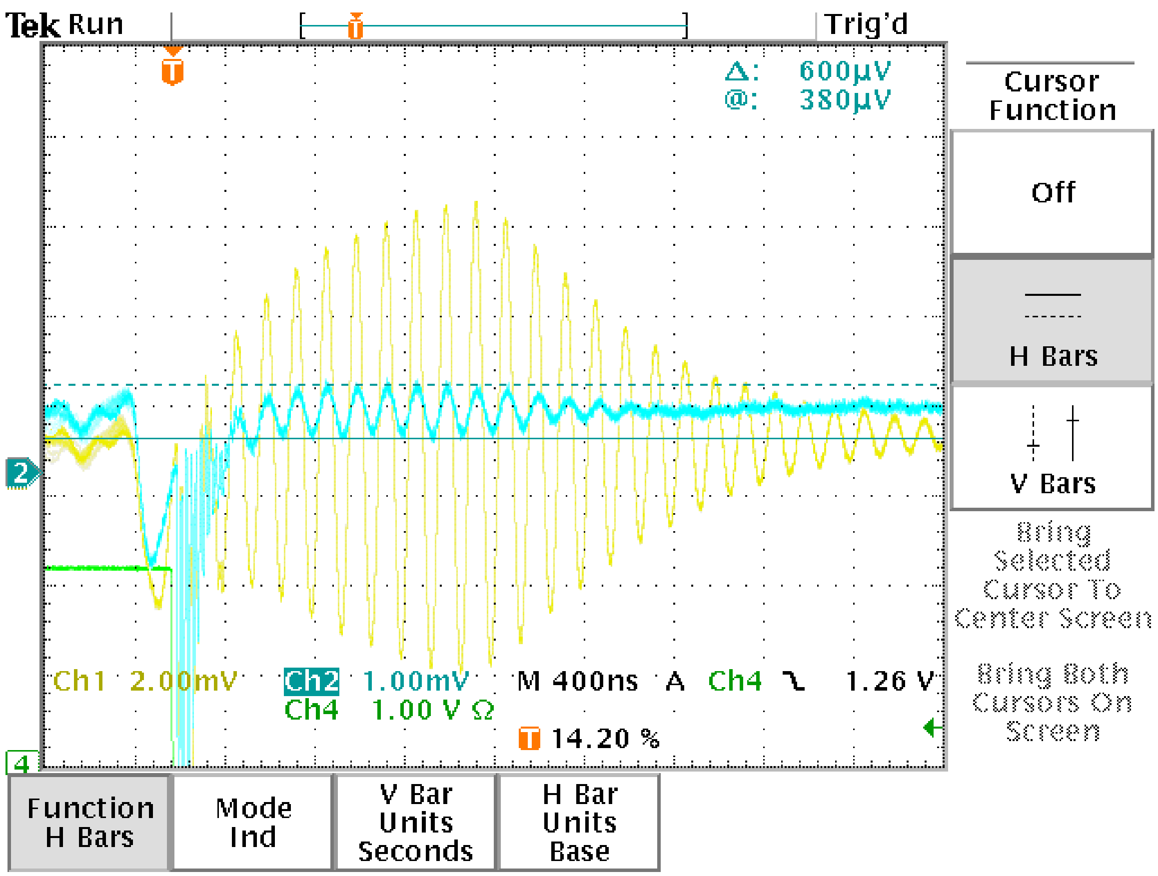
Figure shows a vertical BPM connected to a coupled pre-amp. The input to blue channel has been disconnected at the 15 KΩ and the voltage measured at CH A and CH B at the log amp.




A capacitively decoupled pre-amp has been connected to a vertical BPM.

Data:

Horizontal BPM with coupled pre-amp 7.5 MHz CW RF, 0dBm

| Horizontal BPM | | Both Conn | Ch A disc. | Ch B disc. | | |
|---|---|---|---|---|---|---|
| without 50 Ohm Term | | mV | mV | mV | | |
| | | | | | | |
| | V_Ch A | 65.4 | 15.5 | 57.1 | | |
| | | | | | | |
| | V_Ch B | 64.5 | 57.3 | 18.3 | | |
| | | | | | | |
| | delta T | 0 | 20 | 20 | | |
| | | | | | | |
| | | | | | | |

the time is in nanoseconds and voltages are peak-to-peak.

| | | | | | | |
|---|---|---|---|---|---|---|
| Horizontal BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
| with 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 36.1 | 9.55 | 30.3 | | |
| | | | | | | |
| | V-Ch B | 37.1 | 32.3 | 18.4 | | |
| | | | | | | |
| | delta T | 0 | 22.4 | 18.4 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Vertical BPM with coupled pre-amp 7.5 MHz CW RF, 0 dBm

| | | | | | | |
|---|---|---|---|---|---|---|
| Vertical BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
| with 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 36.1 | 13.7 | 26.4 | | |
| | | | | | | |
| | V-Ch B | 38 | 30 | 18.2 | | |
| | | | | | | |
| | delta T | 0 | 14.4 | 14.4 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Vertical BPM with coupled re-amp 7.5 MHz CW RF, 0 dBm

| | | | | | | |
|---|---|---|---|---|---|---|
| Vertical BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
| without 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 65.7 | 23.5 | 50 | | |
| | | | | | | |
| | V-Ch B | 66.7 | 50 | 25.6 | | |
| | | | | | | |
| | delta T | 0 | 14.4 | 14.4 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Horizontal BPM, Coupled pre-amp 7.5 MHZ PULSE RF, 0 dBm

| | | | | | | |
|---|---|---|---|---|---|---|
| Horizontal BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
| without 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 17.1 | 3.9 | 14.5 | | |
| | | | | | | |
| | V-Ch B | 16.7 | 14.2 | 3.2 | | |
| | | | | | | |
| | delta T | 0 | 24 | 23.2 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Horizontal BPM, Coupled pre-amp 7.5 MHZ PULSE RF, 0 dBm

| Horizontal BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
|---|---|---|---|---|---|---|
| with 50 Ohm Term | | mV | mV | mV | | |
| | V_Ch A | 8.3 | 2.1 | 6.9 | | |
| | | | | | | |
| | V-Ch B | 8.4 | 7.8 | 1.8 | | |
| | | | | | | |
| | delta T | 0 | 24 | 20 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Vertical BPM, Coupled pre-amp 7.5 MHz PULSE RF, 0 dBm

| Vertical BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
|---|---|---|---|---|---|---|
| without 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 16.6 | 5.5 | 12.2 | | |
| | | | | | | |
| | V-Ch B | 16.7 | 12 | 6.2 | | |
| | | | | | | |
| | delta T | 0 | 25.6 | 13.6 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Vertical BPM, Coupled pre-amp 7.5 MHz PULSE RF, 0 dBm

| Vertical BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
|---|---|---|---|---|---|---|
| with 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 8.3 | 3.2 | 6 | | |
| | | | | | | |
| | V-Ch B | 9 | 6.8 | 3 | | |
| | | | | | | |
| | delta T | 0 | 27.2 | 14.4 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Vertical BPM, De-Coupled pre-amp 7.5 MHz PULSE RF, 0 dBm

| Vertical BPM | | Both Conn | Ch A Disc. | Ch B Disc. | | |
|---|---|---|---|---|---|---|
| with 50 Ohm term | | mV | mV | mV | | |
| | V_Ch A | 5.44 | 0.6 | 5.4 | | |
| | | | | | | |
| | V-Ch B | 5.62 | 5.62 | 0.6 | | |
| | | | | | | |
| | delta T | 0 | 4 | 4 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

The above data shows the following:

1. No appreciable difference is seen in signal amplitude (which after the necessary conversion factors really means position) if a pre-amp tuned for a horizontal BPM is used with a vertical BPM.
2. Adding a 50 Ω shunt resistor to the 15KΩ series resistor does not produce a significant phase shift, just attenuates the signal by a factor of two.
3. De-Coupling the pre-amp reduces the unwanted signal in the disconnected channel by a factor of six.

BPM- PreAmp Position Measurements

With all the preliminary data in hand the position and gain measurements and their dependence to sampling time were pursued. The test setup consisted of a horizontal and a vertical BPM connected through a coupled or a de-coupled pre-amp depending of the specific measurement and the driving signal was 7.5 MHz CW or pulsed and 2.5 MHz pulsed.
An intermediate step needed to be taken in order to correlate the MI-60 BPM data with the lab data. The measured voltage form the log amp card needs to be corrected by the following formula:
Position = C0 + C1 * Vout
C0 is the electrical and mechanical offset for a particular BPM
C1 is a BPM gain factor
Therefore a horizontal and vertical BPM was chosen at random (HP525 and VP525), their coefficients obtained from the oper file. Then the measured voltage was corrected and compared to the measured tunnel data corresponding to the two BPM's to try to understand the tunnel data.

| BPM Opewr Coeff | C0 | C1 |
|---|---|---|
| HP525 | 1.6 | -4.76 |
| VP525 | 0.5 | -2.54 |
| | | |

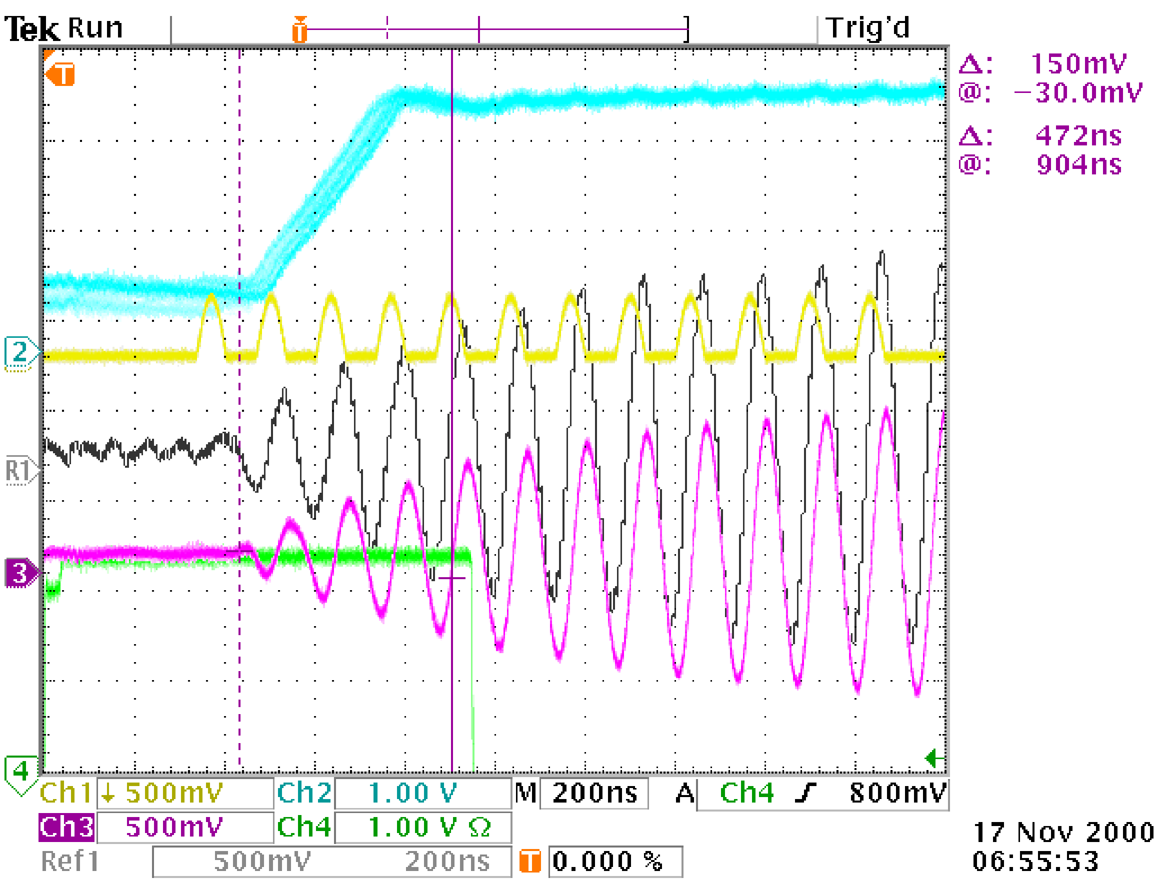
The first set of measurements were:

Horizontal BPM 7.5 MHz CW signal, 0 dBm Sampled @ 500 ns

| | 0 dB pad | 3dB pad Ch A | 3 dB pad Ch B | Gain |
|---|---|---|---|---|
| | mm | mm | mm | mm/dB |
| Hor. BPM | 0.04 | 7 | -7.11 | 2.3 |
| Vert. BPM | -0.71 | 1.55 | -3.01 | 0.76 |
| | | | | |
| Tunnel | | | | |
| HP525 | -2 | 5.3 | -9.2 | 2.41 |
| VP525 | -0.9 | 1.7 | -3.3 | 0.83 |
| | | | | |

Comparing the two sets of data showed good agreement in the channel gain and in the span. Still the gain of the vertical detector is to low and the span to narrow. Sampling time in the CW case is not a factor therefore this aspect was not pursued and the horizontal BPM data was not pursued further.

Pulsed 7.5 MHz




A 7.5 MHz burst replaced the CW signal. Represented by the yellow trace.

Ch3 is the output form the pre-amp measured at the input of the log amp.
Ch2 is the output of the log amp.
Ch4 is the sample and hold trigger.

The measured position for this setup:

| BPMtype | S&H | 0 dB pad | 3dB pad Ch A | 3 dB pad Ch B | Gain | |
|---|---|---|---|---|---|---|
| | ns | mm | mm | mm | mm/dB | |
| Vert. | 280 | -4.4 | -0.31 | -8.85 | 1.42 | |
| | 300 | -2.3 | 2.33 | -6.71 | 1.5 | |
| | 1026 | -2.3 | 0.5 | -5 | 0.95 | |
| | | | | | | |
| Hor. | 1026 | -2.5 | 5.5 | -10.8 | 2.8 | |
| | | | | | | |
| | | | | | | |

Form this data it was determined

1. Capacitive coupling causes channel coupling, reducing the amplitude of the primary signal in effect reducing the overall BPM gain as well as reducing the span by the coupling factor. Therefore sampling earlier where the coupling time constant is minimized is a desirable thing.
2. Holding the signal to early introduces an offset as an effect of two things. Looking at Ch2 in the above picture the output rise time is in the order of 260 ns. Both channels A and B must have the same rise time to provide a near zero volt signal to the subtracting amplifier. The present circuit has an adjustment which controls the DC Gain of the log amp, but adversely affects the rise time of the log amp. The combination of un-matched log rise times and sampling to early produces an artificial 0 dB offset.
3. Hold should be done at the end of the rise time which in this test setup is ~ 320 ns.

De-Coupled Pre-Amp

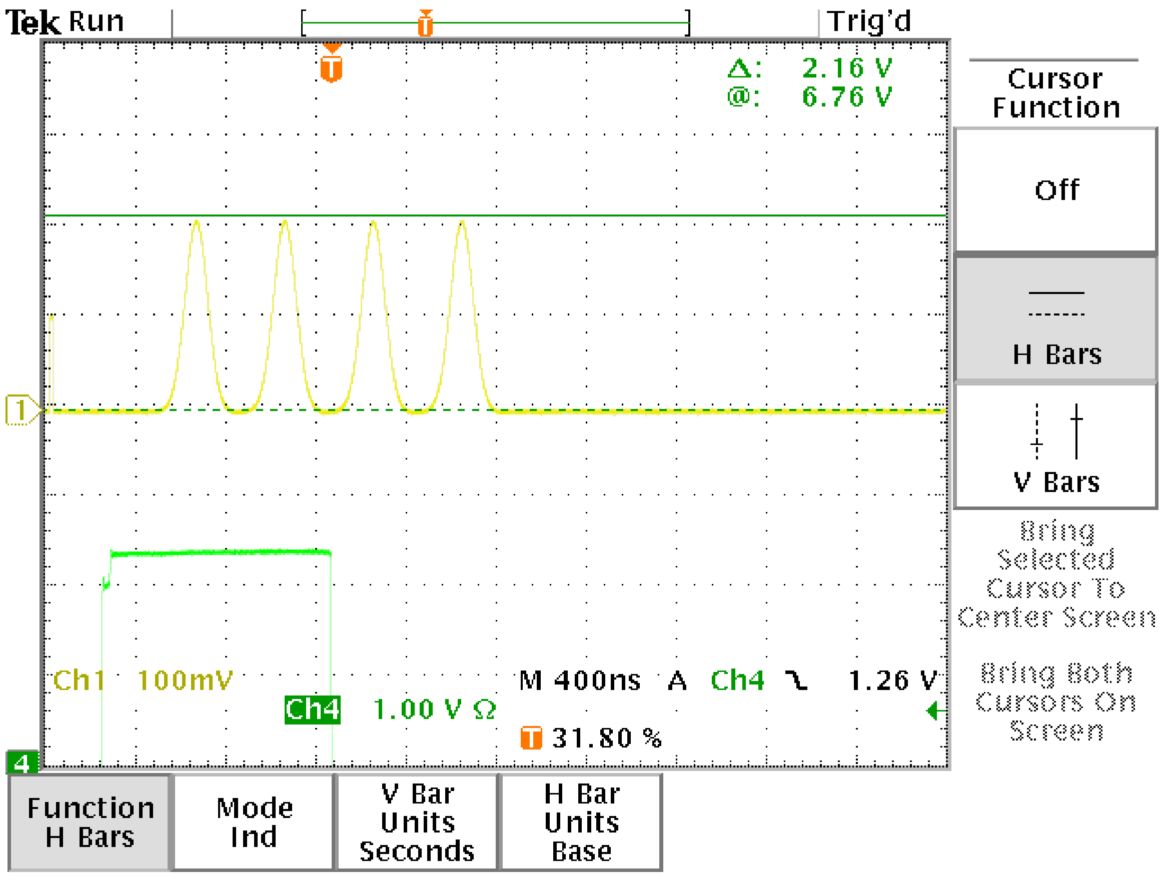
Given the above setup, a capacitively de-coupled pre-amp was substituted to measure the effect of coupling and sampling time.

| BPMtype | S&H | 0 dB pad | 3dB pad Ch A | 3 dB pad Ch B | Gain | |
|---|---|---|---|---|---|---|
| | ns | mm | mm | mm | mm/dB | |
| Vert. | 300 | -4.33 | 0.1 | -8.9 | 1.5 | |
| | 400 | -3.96 | 1.52 | -8.5 | 1.6 | |
| | 500 | -3.31 | 1.77 | -8.1 | 1.67 | |

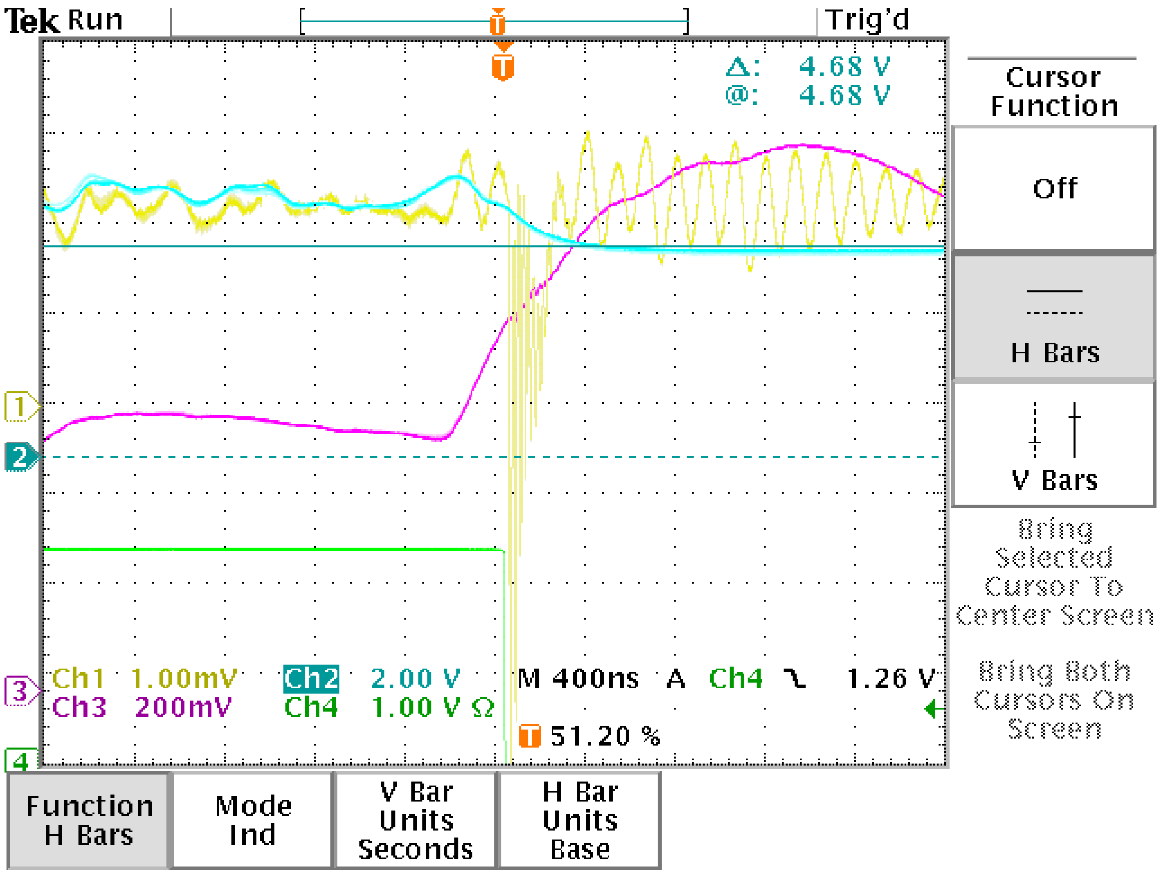
These results showed that sampling later does not reduce the BPM gain since the coupling between the channels has been reduced significantly. The ideal case would be to have de-coupled pre-amps which would allow sampling time position dependency to be elminated.

2.5 MHz Bunches:

Before a conclusion could be drawn from results obtained with a pure 7.5 MHz bunch, four 2.5 MHz bunches were used as a source. This is closer to real running conditions.




This is the four 2.5 MHz bunches injected into the pre-amp.




Ch3 is the log output of Ch1
Ch1 is the output of the pre-amp response to the 4 bunch 2.5 MHz signal.
Ch4 is the S&H signal
Ch2 is the S&H position
The large transient is due to ground-bounce caused by TTL switching, the analog and digital grounds being one on the card.

Measurements:
All done on a vertical BPM exchanging the pre-amp.

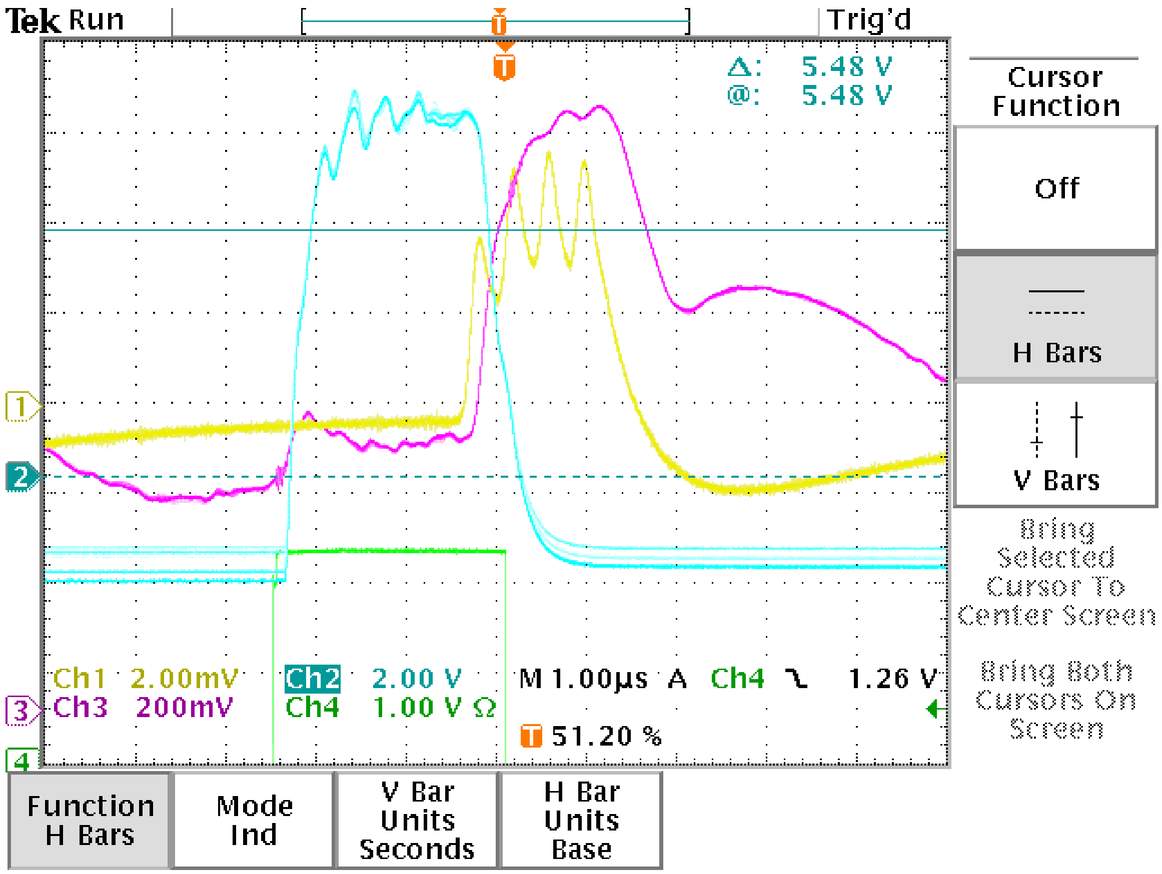
| Pre-Amp | Sample time | 0 dB pad | 3dB pad Ch A | 3 dB pad Ch B | Gain | |
|---|---|---|---|---|---|---|
| Coupled | ns | mm | mm | mm | mm/dB | |
| | 300 | -8.9 | -3.6 | -13.7 | 1.68 | |
| | 500 | -4.7 | -2.2 | -7.12 | 0.8 | |
| | 700 | -5.7 | -2.3 | -8.7 | 1 | |
| | 900 | -2.8 | -0.57 | -4.8 | 0.7 | |
| | 1340 | -1.5 | 0.4 | -3.8 | 0.7 | |
| | | | | | | |
| De-Coupled | 300 | -11.28 | -7.1 | -15.2 | 1.35 | |
| | 500 | -8.65 | -4.4 | -11.7 | 1.22 | |
| | 700 | -5.6 | -0.8 | -10.2 | 1.57 | |
| | 900 | -6.1 | -0.77 | -11.2 | 1.34 | |
| | 1340 | -4.58 | 0.57 | -9.7 | 1.71 | |
| | | | | | | |

The data shows:

1. Four bunches produce enough 7.5 MHz signal to be detected by the log amp.
2. Since there is enough 7.5 MHz signal component generated from the pre-amp, the previously discussed issues, sample time, pre-amp-BPM de-coupling, and log amp channel matching, are central to a working BPM system.

2.5 MHz Pre-amp

As a final measurement a pre-amp with a 2.5 MHz tuned BPF was measured using a 2.5 MHz, four bunch source.




Ch1 is the input to the log amp
Ch3 is the output of the log amp
Ch2 is the S&H position
Ch4 is the S&H signal

Data:

| | 0 dB pad | 3dB pad Ch A | 3 dB pad Ch B | Gain |
|---|---|---|---|---|
| | mm | mm | mm | mm/dB |
| | | | | |
| Vert. BPM | -8.1 | -11.4 | -1.8 | 1.6 |
| | | | | |

These preliminary results indicate that this pre-amp would do the job.

Recommendations: Ideal Case

1. De-Couple the pre-amps.
2. Calibrate the A & B log amps.
3. Correct for zero-position deviations in oper once the above two steps are accomplished.

Real Case:

1. Sample time set to 300 to 350 ns.
2. Increase the oper file gain for the vertical detectors by a factor of 2.
3. Understand the zero-position deviation.